

What is claimed is:

1. A thin-film transistor, comprising:
 - a source electrode;
 - a drain electrode;
 - 5 a gate electrode;
 - a deposited thin-film channel region having a portion doped with an impurity to change the fixed charge density within the portion relative to a remainder of the channel region and disposed between the source and drain electrode; and
 - 10 a dielectric material electrically separating the gate electrode from the channel region.
2. The thin-film transistor of claim 1, where the portion of the channel region is disposed between the remainder of the channel region and the dielectric material.
- 15 3. The thin-film transistor of claim 1, where the dielectric material includes silicon dioxide.
- 20 4. The thin-film transistor of claim 1, where the channel region is a deposited layer fabricated from a binary oxide semiconductor material.
5. The thin-film transistor of claim 4, where the channel region is fabricated from zinc oxide.
- 25 6. The thin-film transistor of claim 4, where the impurity is a donor-type impurity which increases the positive fixed charge density within the portion of the channel region.
- 30 7. The thin-film transistor of claim 4, where the impurity is an acceptor-type impurity which increases the negative fixed charge density within the portion of the channel region.

8. The thin-film transistor of claim 5, where the impurity is a donor-type impurity which increases the positive fixed charge density within the portion of the channel region.

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9. The thin-film transistor of claim 8, where the donor-type impurity is selected from the group consisting of aluminum, boron, gallium, indium, fluorine and chlorine.

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10. The thin-film transistor of claim 8, where the donor-type impurity is aluminum.

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11. The thin-film transistor of claim 5, where the impurity is an acceptor-type impurity which increases the negative fixed charge density within the portion of the channel region.

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12. The thin-film transistor of claim 11, where the acceptor-type impurity is selected from the group consisting of nitrogen, copper, phosphorous, arsenic, antimony, lithium, sodium and potassium.

13. The thin-film transistor of claim 4, where the channel region is fabricated from indium oxide.

14. The thin-film transistor of claim 13, where the impurity is a donor-type impurity which increases the positive fixed charge density within the portion of the channel region.

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15. The thin-film transistor of claim 14, where the donor-type impurity is selected from the group consisting of silicon, germanium, tin, lead, fluorine and chlorine.

16. The thin-film transistor of claim 13, where the impurity is an acceptor-type impurity which increases the negative fixed charge density within the portion of the channel region.

5 17. The thin-film transistor of claim 16, where the acceptor-type impurity is selected from the group consisting of nitrogen, phosphorous, arsenic and antimony.

10 18. The thin-film transistor of claim 4, where the channel region is fabricated from tin oxide.

15 19. The thin-film transistor of claim 18, where the impurity is a donor-type impurity which increases the positive fixed charge density within the portion of the channel region.

20 20. The thin-film transistor of claim 19, where the donor-type impurity is selected from the group consisting of arsenic, antimony, bismuth, fluorine and chlorine.

25 21. The thin-film transistor of claim 18, where the impurity is an acceptor-type impurity which increases the negative fixed charge density within the portion of the channel region.

30 22. The thin-film transistor of claim 21, where the acceptor-type impurity is selected from the group consisting of boron, aluminum, gallium, indium, nitrogen, phosphorus, arsenic and antimony.

35 23. The thin-film transistor of claim 1, where the channel region comprises a controllable electrical pathway between the source electrode and drain electrode.

24. A thin-film transistor, comprising:

a source electrode;

a drain electrode;

a gate electrode;

5 a dielectric insulator; and

a deposited thin-film semiconductive channel,

where the electrodes, dielectric insulator and semiconductive channel are disposed so that the dielectric insulator insulates the gate electrode from the semiconductive channel and from the source electrode and drain electrode and

10 where the semiconductive channel includes a first portion and a second portion, the first portion being doped differently than the second portion so as to achieve a desired variation in a gate threshold voltage required to turn on the thin-film transistor.

15 25. The thin-film transistor of claim 24, where the first portion of the semiconductive channel is positioned adjacent to the dielectric insulator and is closer to the dielectric insulator than the second portion.

26. The thin-film transistor of claim 25, where the first portion of the semiconductive channel is doped with a donor-type impurity to increase positive fixed electrical charge density within the first portion relative to the second portion and thereby produce a negative shift in the gate threshold voltage.

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27. The thin-film transistor of claim 26, where the semiconductive channel is fabricated from zinc oxide and where the donor-type impurity includes aluminum.

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28. The thin-film transistor of claim 25, where the first portion of the semiconductive channel is doped with an acceptor-type impurity to increase negative fixed electrical charge density within the first portion relative to the second portion and thereby produce a positive shift in the gate threshold voltage.

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29. A thin-film transistor, comprising:

a gate electrode;

a source electrode;

a drain electrode;

means for providing a semiconductive electric pathway having selectively controllable conductive properties between the source electrode and the drain electrode; and

means for providing a dielectric for insulating the gate electrode from the semiconductive electric pathway, and from the source electrode and the drain electrode,

where the means for providing a semiconductive electric pathway includes a non-boundary region and a boundary region that is doped differently from the non-boundary region, said boundary region being closer to the means for providing a dielectric than the non-boundary region and doped with an impurity adapted to vary fixed electrical charge density within the boundary region relative to the non-boundary region, where said impurity is selected to achieved a desired variation in a gate threshold voltage required to turn on the thin-film transistor.

30. A method of fabricating a thin-film transistor, comprising:

forming a gate electrode from conductive material;

providing a dielectric material;

5 forming a source electrode and a drain electrode, with the dielectric material disposed to physically separate the gate electrode from the source electrode, and from the drain electrode;

depositing a thin-film channel material adjacent to the dielectric material and so that that the dielectric material is physically interposed between the gate electrode and the thin film channel material; and

10 doping a boundary region between the thin-film channel material and the dielectric material with an impurity to change the fixed electrical charge density within the boundary region relative to remaining channel material.

31. The method of fabricating a thin-film transistor of claim 30, where
15 the method includes forming the boundary region by disposing a layer of material adjacent to and in contact with the dielectric material, and doping the layer to change the fixed electrical charge density within the layer relative to the remaining channel material.

20 32. The method of fabricating a thin-film transistor of claim 30, where doping the boundary region includes introducing a donor-type impurity into the boundary region to increase the positive fixed electrical charge density within the boundary region.

33. The method of fabricating a thin-film transistor of claim 30, where doping the boundary region includes introducing an acceptor-type impurity into the boundary region to increase the fixed electrical charge density within the boundary region.

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34. A thin-film transistor made by a process comprising:
forming a gate electrode, source electrode and drain electrode;
disposing a dielectric material so that the dielectric material separates the gate electrode from the source electrode and from the drain electrode;
10 disposing, via a thin-film process, a channel material so that the channel material is in contact with the dielectric material and so that the channel material separates the source electrode and drain electrode; and
doping a portion of the channel material so that fixed electrical charge density within such portion varies relative to undoped portions of the channel
15 material.

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35. The thin-film transistor made by the process of claim 34, where doping the portion of the channel material includes introducing a donor-type impurity into the portion to increase the positive fixed electrical charge density within the portion of the channel material.

36. The thin-film transistor made by the process of claim 34, where doping the portion of the channel material includes introducing an acceptor-type impurity into the portion to increase the negative fixed electrical charge density within the portion of the channel material.

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37. The thin-film transistor made by the process of claim 34, where a thickness of the portion of the channel material is selected based on a desired gate threshold voltage of the thin-film transistor.

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38. The thin-film transistor made by the process of claim 34, where doping the portion of the channel material is performed so that the portion of the channel material extends between the source electrode and the drain electrode.

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39. A transistor, comprising:

a source electrode;

a drain electrode;

a gate electrode;

a channel region having a portion doped with an impurity to change the fixed charge density within the portion relative to a remainder of the channel region; and

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a dielectric material electrically separating the gate electrode from the channel region, where the portion of the channel is disposed so as to extend between the source electrode and drain electrode along a boundary between the channel region and the dielectric material.

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40. A display, comprising:

a plurality of display elements configured to operate collectively to display images, where each of the display elements includes a thin-film transistor configured to control light emitted by the display element, the thin-film transistor

5 including:

a source electrode;

a drain electrode;

a gate electrode;

10 a deposited thin-film channel region having a portion doped with an impurity to change the fixed charge density within the portion relative to a remainder of the channel region and disposed between the source and drain electrode; and

a dielectric material electrically separating the gate electrode from the channel region.

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41. The display of claim 40, where the channel region is a deposited layer fabricated from a binary oxide semiconductor material.

20 42. The display of claim 41, where the channel region is fabricated from zinc oxide.

43. The display of claim 41, where the channel region is fabricated from tin oxide.

25 44. The display of claim 41, where the channel region is fabricated from indium oxide.

45. The display of claim 41, where the impurity is a donor-type impurity which increases the positive fixed charge density within the portion of the channel region.

5 46. The thin-film transistor of claim 41, where the impurity is an acceptor-type impurity which increases the negative fixed charge density within the portion of the channel region.